

AMENDMENTS TO THE CLAIMS

The listing of claims will replace all prior versions, and listings, of claims in the application:

Listing of Claims:

1. (Currently Amended) An organic contaminant molecule sensor for use in a process environment having a low oxygen concentration comprising:

an electrochemical cell comprising:

a solid state oxygen anion conductor in which oxygen anion conduction occurs at or above a critical temperature;

a measurement electrode formed on a first surface of the anion conductor for exposure to the monitored environment, the measurement electrode comprising a material for catalyzing the dehydrogenation of an organic contaminant molecule wherein at temperatures below the critical temperature, organic contaminant molecules are adsorbed onto and dehydrogenated at the surface of the material of the measurement electrode to form a carbonaceous deposit on the surface of the material of the measurement electrode; and

a reference electrode formed on a second surface of the anion conductor for exposure to a reference environment, the reference electrode comprising a material for catalyzing the dissociation of oxygen to oxygen anions;

a heater for controlling the temperature of the electrochemical cell in a manner that the heater sets a temperature of the solid state oxygen anion conductor below the

critical temperature during an adsorption phase, and at or above the critical temperature during a titration phase; and

a current source for controlling the electrical current between the reference electrode and the measurement electrode wherein at temperatures above the critical temperature, an electrical current is passed between the reference electrode and the measurement electrode to control the number of oxygen anions passing from the reference electrode to the measurement electrode to oxidize the carbonaceous deposit.

2. (Previously Presented) The sensor according to Claim 1 wherein the measurement electrode comprises a metal selected from the group of metals consisting of rhenium, osmium, iridium, ruthenium, rhodium, platinum and palladium and alloys thereof.

3. (Previously Presented) The sensor according to Claim 2 wherein the alloys include an element selected from the group of elements consisting of silver, gold and copper.

4. (Cancelled)

5. (Previously Presented) The sensor according to Claim 3 wherein the reference electrode comprises a metal capable of dissociating oxygen.

6. (Previously Presented) The sensor according to Claim 1 wherein the solid state oxygen anion conductor is selected from the group of conductors consisting of gadolinium doped ceria and yttria stabilized zirconia.

7. (Previously Presented) The sensor according to Claim 1 comprising a counter electrode positioned adjacent to the reference electrode.

8. (Previously Presented) The sensor according to Claim 7 wherein the counter electrode comprises a metal capable of dissociating oxygen.

9. (Previously Presented) The sensor according to Claim 1 comprising a reference environment having a gaseous source of oxygen at atmospheric pressure.

10. (Previously Presented) The sensor according to Claim 1 wherein the reference environment comprises a solid state source of oxygen.

11. (Previously Presented) The sensor according to Claim 10 wherein the solid state source of oxygen comprises a metal/metal oxide compound.

12. (Previously Presented) The sensor according to Claim 1 wherein the heater further includes a thermocouple assembly.

13. (Previously Presented) The sensor according Claim 1 further including means for measuring a potential across the sensor.

14. (Previously Presented) The sensor according to Claim 13 wherein the sensor monitors the levels of trace organic contaminants in a low oxygen concentration monitored process environment.

15. (Withdrawn) A method of monitoring the levels of trace organic contaminants in a process environment comprising the steps of:

providing an electrochemical sensor comprising a solid state oxygen anion conductor in which oxygen anion conduction occurs at or above a critical temperature, a measurement electrode formed on a first surface of the conductor for exposure to the process environment, the measurement electrode comprising a material for catalyzing the dehydrogenation of the trace organic contaminants, and a reference electrode formed on a second surface of the conductor for exposure to a reference environment, the reference electrode comprising a material for catalyzing the dissociation of oxygen to oxygen anions;

exposing the measurement electrode at a sensor temperature T_{ads} to the process environment for a time t_{ads} to cause one or more of the trace organic contaminants to adsorb onto and dehydrogenate at the surface of the measurement electrode thereby leading to build up of a carbonaceous deposit at the surface of the measurement electrode;

raising the temperature of the electrochemical sensor to a value T_{tit} above the critical temperature of the solid state oxygen anion conductor and passing a current I_p between the reference electrode and the measurement electrode for a time t_p sufficient for the potential difference across the electrochemical sensor to reach a constant value

determined by the equilibrium between the flux of oxygen anions arriving at the measurement electrode and the rate of desorption of oxygen gas from the reference electrode; and

determining, from a total charge ($I_p t_p$) passed through the electrochemical sensor at temperature T_{tit} , the amount of carbonaceous deposits present at the surface of the measurement electrode and therefore the concentration of trace organic contaminants in the process environment.

16. (Withdrawn) The method according to Claim 15 further comprising the step of raising the temperature of the electrochemical sensor to a temperature between T_{ads} and T_{tit} prior to the step of raising the temperature of the electrochemical sensor to T_{tit} .

17. (Withdrawn) The method according to Claim 15 wherein T_{ads} is from 20 to 150°C.

18. (Withdrawn) The method according to Claim 15 wherein t_{ads} is from 102 to 105 seconds.

19. (Withdrawn) The method according to Claim 18 wherein t_{ads} is about 104 seconds.

20. (Withdrawn) The method according to Claim 15 wherein T_{tit} from 300 to 600°C.

21. (Withdrawn) The method according to Claim 15 wherein I_p is from 10nA to 100uA.

22. (Withdrawn) The method according to Claim 15 wherein the electrochemical sensor comprises a counter electrode positioned adjacent to the reference electrode.

23. (Withdrawn) The method according to Claim 15 wherein the reference environment comprises a source of oxygen at atmospheric pressure.

24. (Withdrawn) The method according to Claim 15 wherein the reference environment comprises a solid-state source of oxygen.

25. (Withdrawn) The method according to Claim 24 wherein the solid state source of oxygen comprises a metal/metal oxide compound or a metal oxide/metal oxide compound.

26. (Withdrawn) The method according to Claim 15 comprising the step of applying a potential V_i across the electrochemical sensor.

27. (Previously Presented) The sensor according Claim 12 further including a device for measuring a potential across the sensor.

28. (Previously Presented) The sensor according to Claim 27 wherein the sensor monitors the levels of trace organic contaminants in a low oxygen concentration monitored process environment.

29. (Previously Presented) The sensor according to Claim 12 wherein the measurement electrode comprises a metal selected from the group of metals consisting of rhenium, osmium, iridium, ruthenium, rhodium, platinum and palladium and alloys thereof.

30. (Previously Presented) The sensor according to Claim 29 wherein the alloys include an element selected from the group of elements consisting of silver, gold and copper.

31. (Previously Presented) The sensor according to Claim 7 wherein the heater further includes a thermocouple assembly.

32. (Previously Presented) The sensor according Claim 31 further including means for measuring a potential across the sensor.

33. (Previously Presented) The sensor according to Claim 32 wherein the sensor monitors the levels of trace organic contaminants in a low oxygen concentration monitored process environment.

34. (Previously Presented) The sensor according to Claim 33 wherein the reference electrode comprises platinum, palladium or other metal capable of dissociating oxygen.

35. (Previously Presented) The sensor according to Claim 7 wherein the measurement electrode comprises a metal selected from the group of metals consisting of rhenium, osmium, iridium, ruthenium, rhodium, platinum and palladium and alloys thereof.

36. (Previously Presented) The sensor according to Claim 35 wherein the alloys include an element selected from the group of elements consisting of silver, gold and copper.

37. (Previously Presented) The sensor according to Claim 13 wherein the measurement electrode comprises a metal selected from the group of metals consisting of rhenium, osmium, iridium, ruthenium, rhodium, platinum and palladium and alloys thereof.

38. (Previously Presented) The sensor according to Claim 37 wherein the alloys include an element selected from the group of elements consisting of silver, gold and copper.

39. (Previously Presented) The sensor according to Claim 38 wherein the reference electrode comprises a catalyst for the dissociation of oxygen.

40. (Previously Presented) The sensor according to Claim 39 wherein the reference electrode comprises a metal capable of dissociating oxygen.

41. (Previously Presented) The sensor according to Claim 13 wherein the solid state oxygen anion conductor is selected from the group of conductors consisting of gadolinium doped ceria and yttria stabilized zirconia.

42. (Previously Presented) The sensor according to Claim 13 comprising a reference environment having a gaseous source of oxygen at atmospheric pressure.

43. (Previously Presented) The sensor according to Claim 13 wherein the reference environment comprises a solid state source of oxygen.

44. (Previously Presented) The sensor according to Claim 43 wherein the solid state source of oxygen comprises a metal/metal oxide compound.

45. (Previously Presented) The sensor according to Claim 5 wherein the metal capable of dissociating oxygen is selected from the group of metals consisting of platinum and palladium.

46. (Previously Presented) The sensor according to Claim 8 wherein the metal capable of dissociating oxygen is selected from the group of metals consisting of platinum and palladium.

47. (Previously Presented) A sensor according to Claim 10 wherein the solid state source comprises a metal oxide/metal oxide compound.

48. (Previously Presented) The sensor according to Claim 40 wherein the metal capable of dissociating oxygen is selected from the group of metals consisting of palladium and platinum.

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49. (Previously Presented) The sensor according to Claim 43 wherein the solid state source of oxygen comprises a metal oxide/metal oxide compound.